

REMARKS

Claims 1-33 were pending in the above-identified application. Claims 1-18 and 30-33 are subjected to a restriction requirement: the remaining claims 19-29 are rejected. Applicants respectfully request reconsideration.

Election of Claims

The examiner imposed a restriction requirement, grouping the originally filed claims into Group I, consisting of claims 1-18 and 30-33, and Group II, consisting of claims 19-29. During a telephone conference with the examiner, the undersigned elected to pursue the claims of Group II. Applicants hereby affirm that election.

Rejections Under 35 U.S.C. §112, First Paragraph

Claims 19-29 stand rejected under the first paragraph of section 112 for failure to enable. The examiner writes:

the specification, while being enabling for the cleaning of the showerhead, does not reasonably provide enablement for cleaning any semiconductor process equipment.

(OA, page 3). Regarding the scope of the claim term "semiconductor process equipment," the examiner writes:

The claims embrace an invention which contains any known semiconductor process equipment (i.e., chuck, piping, wafer, spray nozzle), which could/can be selected from literally thousands. It does not appear feasible that any semiconductor process equipment would function in the present invention.

(OA, page 4).

The label "semiconductor process equipment" is well known to those skilled in semiconductor processing. As the examiner notes, many items and assemblies fall within the meaning of this phrase. Applicants disagree, however, with

the examiner's assertion that those of skill in the art would be unable to apply the claimed method to process equipment other than the particular showerhead detailed in applicants' disclosure. The examiner is impermissibly attempting to limit the claims to one specific example, despite the specification's express recitation of applicability to other type of equipment. The specification notes in paragraph [0025], for example, that "the invention is not limited to showerheads, but may be used to clean other components with hard-to-reach surfaces."

The rejection is based upon the examiner's assertion that "there would clearly be undue experimentation to do so in an attempt to figure out which component channels work and which ones do not" (Office action, page 4). Applicants fail to understand the examiner's concern. Those of skill in the art, faced with a hard-to-reach surface contaminated with a reaction product of aluminum and a halogen, could certainly test the efficacy of steam cleaning in the manner claimed. For example, the examiner identifies a nozzle as a type of semiconductor process equipment that falls within the scope of the terms "process equipment" in claim 1, and that might be contaminated with a reaction product. Applicants agree, but fail to understand the difficulty of determining whether a reaction product of aluminum and a halogen may be removed from a nozzle by forcing steam through the nozzle. A common-sense approach might be to simply force steam through a contaminated nozzle and check to see whether the application of steam removed the contaminant. Such experiments are certainly within the ability of those of skill in the art. The rejection of claims 19-29 under the first paragraph of section 112 should therefore be withdrawn.

Rejections Under 35 U.S.C. §112, Second Paragraph

Claims 19-29 stand rejected under the second paragraph of section 112 as indefinite. Applicants treat each rejection in turn below.

Claim 19

The examiner asserts that claim 19 is indefinite because:

1. "it is unclear what one of ordinary skill would consider as 'reaction products';"
2. "it is unclear whether the interior or exterior surface of the equipment is cleaned"; and
3. "it is also unclear what one of ordinary skill in the art would consider as "semiconductor process equipment."

(Office Action, page 4.)

With respect to the first point, claim 19 is amended to recite "reaction products of aluminum and a halogen," removing any potential ambiguity about the meaning of "reaction products." As to the second point, the method of amended claim 19 includes "forcing steam through holes in the semiconductor process equipment to remove the reaction products from the holes." The recited holes are clearly "interior surfaces," so there should be no ambiguity concerning interior or exterior surfaces. Finally, as noted above, the phrase "semiconductor process equipment" is notoriously well known to those of skill in the art, and includes any equipment used in the processing of semiconductors.

Incidentally, in referring to a "wafer" (OA, page 4), the examiner appears to be mistaking a semiconductor substrate for a type of semiconductor process equipment. Semiconductors substrates, or "wafers," cannot be considered "semiconductor process equipment" any more than

clothing can be considered a washing machine: in both cases, the former is "processed" within the latter.

The foregoing amendments and remarks address each issue raised by the examiner. The terms of claim 19 are well understood by those familiar with the relevant art, and are in no way indefinite. The rejection of claim 19 should therefore be withdrawn.

Claims 22 and 23

Claims 22 and 23 stand rejected as indefinite because "the steam pressure" and "the steam temperature" lack positive antecedent basis. Applicants disagree with the requirement for antecedent basis for those terms, as temperature and pressure are inherent properties of steam. Applicants have nonetheless amended claims 22 and 23 to overcome the rejections.

Claim 28

Claim 28 stands rejected as indefinite due to the recitation of "water equipment" without antecedent basis. The inclusion of the term "water" was a typographical error, so that word is deleted by this amendment. Applicants appreciate the examiner's attention to detail.

Claim 29

Claim 29 is cancelled, rendering moot the rejection of that claim.

Rejections Under 35 U.S.C. §102 under Chen et al.

Claims 19-21, 23-27, and 29 stand rejected under §102(b) as anticipated by Chen et al. (U.S. Patent 5,545,289). This rejection is respectfully traversed in view of the following remarks.

Claim 19

Claim 19, as amended, recites a method of "removing reaction products of aluminum and a halogen" by "forcing steam through holes...to remove the reaction product from the holes." The examiner believes

Chen et al. teach a method of stripping halogen etchant byproducts from a semiconductor substrate using water vapor, oxygen and nitrogen (col. 1, lines 35-55, col. 2, lines 5-10, col. 3, lines 60-65, col. 7, lines 5-25, col. 7, lines 55-65)"

(OA, page 5). Applicants respectfully disagree.

Firstly, the "semiconductor substrates" of Chen et al. cannot be considered "semiconductor process equipment" any more than clothing can be considered a washing machine. Chen et al. do not anticipate claim 19 because Chen et al. do not teach any method of removing reaction byproducts from semiconductor process equipment, as recited in claim 19. Secondly, the stripping methods identified by the examiner are not for removing reaction products of aluminum and a halogen, but are intended to remove remnant resist. In Chen et al., reaction products are not stripped, but are instead passivated. Chen et al. teach, for example:

In the passivating process, substantially all the etchant byproducts 24...are passivated using a passivating gas plasma. In the stripping process, substantially all the remnant resist 26 is stripped using a stripping gas plasma.

(Chen et al., col. 5, lines 30-34). Chen et al. do remove some etchant byproducts; for example, the sidewall deposits of Chen et al. are removed by wet chemical etching (Id. at col. 5, lines 36-37). These deposits are not, however, removed by application of steam at all, much less in the manner claimed.

Chen et al. teach the use of water vapor to remove polymeric resist (col. 8, lines 23 and 24), but do not suggest that water vapor is effective in removing etchant byproducts. Chen et al. instead believe "that the water vapor addition results in passivating of some of the etchant byproducts" (col. 8, lines 31 and 32). This statement suggests using some water to passivate etchant byproducts, not to remove them. This is perhaps why Chen et al. employ wet chemical etching to remove the sidewall deposits (col. 11, lines 45-60) after the wafer is stripped of resist using e.g. water vapor.

Claim 19

Amended claim 19 recites, in total,

A method for removing reaction products of aluminum and a halogen from semiconductor process equipment, the method comprising forcing steam through holes in the semiconductor process equipment to remove the reaction products from the holes.

(Claim 19, emphasis in original to highlight amendment.) Chen et al. make no mention of removing reaction products from semiconductor process equipment, do not teach forcing steam through holes to remove reaction products from those holes, and do not teach the removal of reaction products of aluminum and a halogen using steam. Chen et al. cannot, therefore, be said to anticipate claim 19. The rejection of claim 19 should therefore be withdrawn.

Claim 20

Claim 20 is cancelled, rendering the rejection of that claim moot.

Claims 21 and 23

Claims 21 and 23 depend from claim 19, and consequently distinguish Chen et al. for at least the same reasons claim 19 distinguishes. The rejections of those claims should therefore be withdrawn.

Claim 24

Claim 24 depends on claim 19, and consequently distinguishes Chen et al. for at least the same reasons claim 19 distinguishes. Claim 24 further limits the process equipment of claim 19 to "a gas diffusion plate perforated with the holes." Chen et al. in no way suggest forcing steam through holes in a gas diffusion plate, so claim 24 further distinguishes that reference.

Claims 25-27

Claims 25 through 27 depend from claim 19, and consequently distinguish Chen et al. for at least the same reasons claim 19 distinguishes. These claims in addition recite soaking steps that are nowhere discussed in Chen et al., and that consequently further distinguish that reference.

Claim 29

Claim 29 is cancelled, rendering the rejection of that claim moot.

Rejections Under 35 U.S.C. §103

Claims 22 and 28 stand rejected under §103 as unpatentable over Chen et al. in view of Mehta et al. (U.S. Patent 5,356,482). Specifically, the examiner argues that "it would have been obvious...to have modified the method of Chen et al. to include a pressure greater than 1 atmosphere, as taught by Mehta et al., for purposes of

condensing the steam vapor..." Applicants once again disagree.

Chen et al. teach a process of stripping photoresist using "a plasma of water vapor, oxygen, and nitrogen" (col. 3, lines 62-63). The cited plasma is formed at relatively low pressures, far lower than atmospheric. Whereas atmospheric pressure is about 760 Torr, the chamber pressures suggested in Chen et al. for use with water-vapor plasmas are e.g. 2 Torr (col. 20, lines 35-36). Applicants do not believe a plasma can be sustained, given the other parameters provided by Chen et al., at pressures approaching 760 Torr. Chen et al. thus teach away from steam pressures in the claimed range. Claims 22 and 28 thus further distinguish the references.

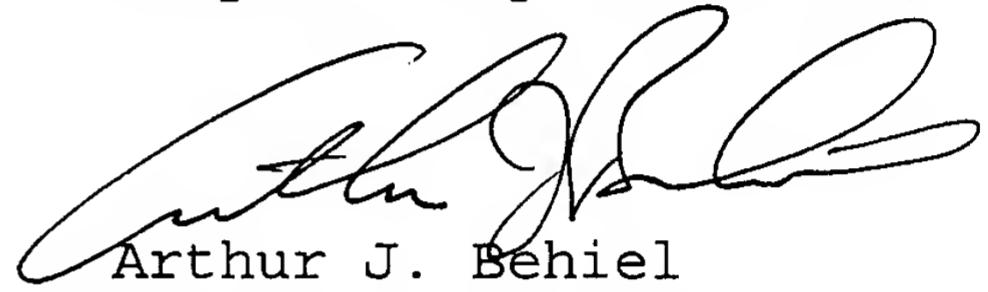
New Claims

Applicants have added new claims 34-46. Independent claim 34 recites a "method for removing reaction products of aluminum and a halogen from a component of semiconductor process equipment." In the method, the component is cleaned by "providing a steam source adapted to produce steam at a pressure greater than atmospheric pressure" and "directing the steam through the channel." This method is similar to claim 19, though the term "channel" is not limited to holes. Claim 19 is believed to be allowable over the cited art for reasons similar to those recited above in connection with the rejection of claim 19. Claims 35-46 depend from claim 34, and consequently distinguish the references for at least the same reasons claim 34 distinguishes.

CONCLUSION

For the reasons presented above, pending claims 19-28 and 34-46 are in condition for allowance; accordingly, Applicants respectfully request a Notice of Allowance. If the Examiner's next action is other than allowance of the pending claims, the Examiner is requested to call Applicants' representative at (925) 621-2113.

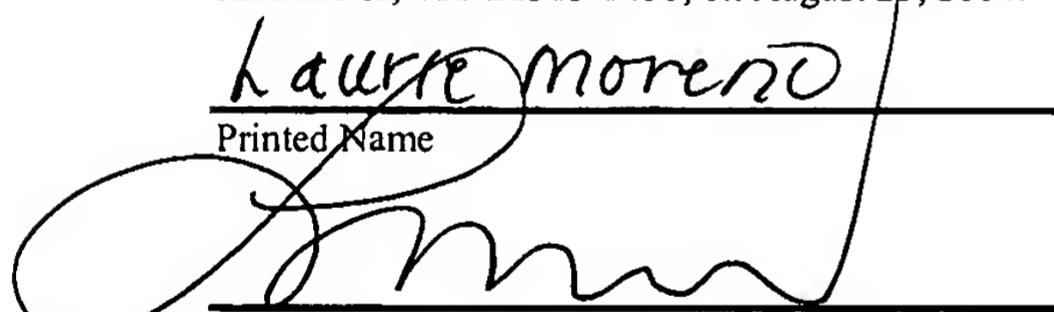
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I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Mail Stop, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on August 23, 2004.

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